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**Total Maximum Daily Load of Sediment
in the Lower North Branch Potomac River Watershed,
Allegany County, Maryland**

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List of Abbreviations

BIBI	Benthic Index of Biotic Integrity
BIP	Buffer Incentive Program
BMP	Best Management Practices
CBP P5	Chesapeake Bay Program Phase V
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
EOF	Edge-of-Field
EOS	Edge-of-Stream
EPA	Environmental Protection Agency
EPSC	Environmental Permit Service Center
ETM	Enhanced Thematic Mapper
FIBI	Fish Index of Biologic Integrity
GIS	Geographic Information System
LA	Load Allocation
MDE	Maryland Department of the Environment
MBSS	Maryland Biological Stream Survey
MGD	Millions of Gallons per Day
mg/l	Milligrams per liter
MOS	Margin of Safety
MS4	Municipal Separate Stormwater System
NPS	Non-Point Source
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRI	National Resource Inventory
PCS	Permit Compliance System
RESAC	Regional Earth Science Applications Center
S&E	Sediment & Erosion
TMDL	Total Maximum Daily Load

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TSS	Total Suspended Solids
TM	Thematic Mapper
USGS	United States Geological Survey
WLA	Waste Load Allocation
WQIA	Water Quality Improvement Act
WQLS	Water Quality Limited Segment
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

This document, upon approval by the U.S. Environmental Protection Agency (EPA), establishes a Total Maximum Daily Load (TMDL) for sediment in the Lower North Branch Potomac River Watershed (basin number 02-14-10-01). Section 303(d) of the federal Clean Water Act (CWA) and the EPA's implementing regulations direct each state to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the state is required to either establish a TMDL of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met (CWA, 2006).

The Maryland Department of the Environment (MDE) has identified the waters of the Lower North Branch Potomac River (basin number 02-14-10-01) on the State's 303(d) List submitted to the U.S. Environmental Protection Agency (EPA) by MDE as impaired by nutrients (1996), sediments (1996), pH (1996), metals - cadmium (1996), bacteria (2002), and portions of the basin for impacts to biological communities (2002) (MDE 2006a). The designated use of the Lower North Branch Potomac River is Use I (Nontidal Water Contact Recreation and Protection of Aquatic Life) (COMAR, 2006a). This document proposes to establish a TMDL for sediments in the Lower North Branch Potomac River watershed to allow for the attainment of the above mentioned designated use. The objective of the sediment TMDL established in this document is to ensure that there will be no sediment impacts affecting aquatic health, when aquatic health is evaluated based on Maryland's biocriteria (Roth *et al.*, 2000, Roth *et al.*, 1998 and Stribling *et al.*, 1998), thereby establishing a sediment loading limit that supports the Use I designation for the Lower North Branch Potomac River watershed. The watershed sediment load includes the potential effects on water clarity and erosional and depositional impacts, thus accounting for all of the sediment impacts that indicate a sediment impairment pursuant to the Maryland 303(d) listing methodology (MDE, 2006b).

A data solicitation for sediments was conducted by MDE, and all readily available data from the past five years have been considered. A Water Quality Analysis (WQA) for the low pH listing has been submitted to the EPA (2005). A WQA for Cadmium has also been submitted to the EPA (2006). The listings for nutrients, bacteria, and impacts to biological communities will be addressed separately at a future date.

The computational framework chosen for the Lower North Branch Potomac River Watershed TMDL was EPA's Chesapeake Bay Program Phase V (CBP P5) watershed model target edge-of-field (EOF) land use sediment loading rate calculations. The edge-of-stream (EOS) sediment load is calculated per land use as a product of the land use area, land use target loading rate, and loss from the EOF to the main channel. The spatial effect of sediment delivery from EOF to EOS is captured as a function of the average transport distance from individual land uses within the model segment. Therefore, each land use category will have a specific sediment delivery ratio. The spatial domain of the

CBP P5 model segmentation aggregates to the Maryland 8-digit watersheds. The Lower North Branch Potomac River watershed is represented by four CBP P5 model segments.

In the absence of numeric sediment criteria, a reference sediment yield approach was applied to determine the assimilative capacity of the watershed stream system. The reference yield was estimated from watersheds that are identified as supporting aquatic life based on Maryland's biocriteria (see Roth *et al.*, 2000, Roth *et al.*, 1998 and Stribling *et al.*, 1998). To reduce the variability when comparing watersheds within and across regions, the watershed sediment yield is normalized by a constant background condition. The normalized sediment yield for this TMDL is calculated as the current watershed sediment load divided by the forest sediment load expected from an all-forested condition.

Biological results from the DNR Core/Trend stations located on the mainstem indicate that the water quality can be classified as fair to good with slightly improving water quality. Based on the reference sediment yield approach, it is estimated that the Potomac River Lower North Branch Watershed just exceeds the upper quartile of the reference watersheds' normalized sediment loads. While it could be classified as slightly impaired, it exhibits an increasing trend of improving water quality. Accounting for the reduction from upstream TMDLs currently under development, the mainstem would not be classified as impaired.

Assessment of the local Maryland tributaries draining to the mainstem indicates that there is a sediment impairment based on an estimated normalized sediment load of 4.38 times the all-forest condition. However, embeddedness and epifaunal substrate scores from the Maryland Biological Stream Survey (MBSS) do not indicate a significant deviation from reference sites (see section 2.3 for details on embeddedness and epifaunal substrate). Upon further evaluation of the MBSS site locations, it was determined that many of the sites are located upstream of the potential sediment source, the urban land use. It was concluded that based on the normalized sediment load, the Maryland tributaries draining to the mainstem of the Lower North Branch Potomac River are likely impaired by elevated sediment loads.

The critical condition for this TMDL is inherently addressed based on the biological monitoring data used to determine the reference watersheds. Seasonality is captured in two components. First, it is implicitly included in biological sampling since results integrate the stress effects over the course of time. Second, the MBSS sampling included benthic sampling in the spring and fish sampling in the summer.

All TMDLs must include a margin of safety (MOS) to account for any lack of knowledge and uncertainty concerning the relationship between loads and water quality (CWA, 2006). Analysis of the reference group sediment yields indicates that approximately 75% of the reference watersheds have a normalized reference yield less than 3.6 and 50% of the normalized yields are less than 3.3. The reference yield is set at the median value of 3.3. This is an environmentally conservative estimate, since 50% of the reference watersheds have a normalized sediment yield above this value, and results in an implicit

margin of safety of approximately 8%. Sediment reductions will occur in the Lower North Branch Potomac River mainstem as a result of this TMDL, which addresses the Maryland 8-digit Lower North Branch Potomac River Watershed. Further analysis indicates that with the reductions from this TMDL and upstream sediment TMDLs (under development), the normalized sediment load for the Lower North Branch Potomac River watershed is within the typical MOS incorporated in Maryland's non-tidal sediment TMDLs.

The total sediment load from the Lower North Branch Potomac River watershed is 7,363.7 tons per year. The sediment TMDL for the Lower North Branch Potomac River watershed is 5,553.6 tons per year. The load allocation (LA) is 5,542.0 tons per year and the waste load allocation (WLA) is 10.7 tons per year. This TMDL will ensure that the sediment loads and resulting effects are at a level to support the Use I designation for the Lower North Branch Potomac River watershed, and more specifically at a level to support aquatic health.

Once the EPA has approved this TMDL, and it is known what measures must be taken to reduce pollution levels, implementation of best management practices (BMPs) is expected to take place. MDE intends for the required reduction to be implemented in an iterative process that first addresses those sources with the largest impact to water quality, with consideration given to ease and cost of implementation.

Maryland has several well-established programs to draw upon, including the Water Quality Improvement Act of 1998 (WQIA) and the Federal Nonpoint Source Management Program (§ 319 of the Clean Water Act). Several potential funding sources for implementation are available, such as the Buffer Incentive Program (BIP), the State Water Quality Revolving Loan Fund, and the Stormwater Pollution Cost Share Program.

1.0 INTRODUCTION

This document, upon approval by the U.S. Environmental Protection Agency (EPA), establishes a Total Maximum Daily Load (TMDL) for sediments in the Lower North Branch Potomac River watershed (basin number 02-14-10-01). Section 303(d)(1)(C) of the federal Clean Water Act (CWA) and EPA implementing regulations direct each state to develop a TMDL for each impaired water quality limited segment (WQLS) on the Section 303(d) List, taking into account seasonal variations and a protective margin of safety (MOS) to account for uncertainty (CWA, 2006). A TMDL reflects the total pollutant loading of the impairing substance a waterbody can receive and still meet water quality standards.

TMDLs are established to determine the pollutant load reductions needed to achieve and maintain water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as swimming, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

The Maryland Department of the Environment (MDE) has identified the waters of the Lower North Branch Potomac River (basin number 02-14-10-01) on the State's 303(d) List submitted to the U.S. Environmental Protection Agency (EPA) by MDE as impaired by nutrients (1996), sediments (1996), pH (1996), metals - cadmium (1996), bacteria (2002), and portions of the basin for impacts to biological communities (2002) (MDE 2006a). The designated use of the Lower North Branch Potomac River is Use I (Nontidal Water Contact Recreation and Protection of Aquatic Life) (COMAR, 2006a). This document proposes to establish a TMDL for sediments in the Lower North Branch Potomac River watershed to allow for the attainment of the above mentioned designated use. The objective of the sediment TMDL established in this document is to ensure that there will be no sediment impacts affecting aquatic health, when aquatic health is evaluated based on Maryland's biocriteria (Roth *et al.*, 2000, Roth *et al.*, 1998 and Stribling *et al.*, 1998), thereby establishing a sediment loading limit that supports the Use I designation for the Lower North Branch Potomac River Watershed. The watershed sediment load includes the potential effects on water clarity and erosional and depositional impacts, thus accounting for all of the potential impacts that indicate a sediment impairment per the Maryland 303(d) listing methodology (MDE, 2006b).

A data solicitation for sediments was conducted by MDE, and all readily available data from the past five years have been considered. A Water Quality Analysis (WQA) for the low pH listing has been submitted to the EPA (2005). A WQA for Cadmium has also been submitted to the EPA (2006). The listings for nutrients, bacteria, and impacts to biological communities will be addressed separately at a future date.

2.0 SETTING AND WATER QUALITY DESCRIPTION

2.1 General Setting

Location

The North Branch of the Potomac River forms the border between Maryland and West Virginia from its origin at the Fairfax Stone downstream to its confluence with the South Branch of the Potomac. The Lower North Branch of the Potomac River is defined as the reach between its confluence with the Savage River and the South Branch of the Potomac River (Figure 1). Wills Creek flows through the City of Cumberland discharging into the Lower North Branch. The drainage area of the Lower North Branch Potomac River watershed is 73,144 acres.

Geology/Soils

The Lower North Branch Potomac River watershed is situated within the Ridge and Valley Provinces in western Maryland. The surficial geology of the Ridge and Valley Provinces is characterized by strongly folded and faulted sedimentary rock, producing a rugged surface terrain. Folding has produced elongated arches across the region, which exposes Devonian rock at the surface. The topography in the watershed is often steep and deeply carved by winding streams, with elevations ranging up to 2,800 feet.

The Lower North Branch Potomac River watershed is comprised of several different soil series including the Ernest and Allegheny series. The Ernest soil series consists of deep, moderately well-drained, loamy soils. These nearly level to moderately steep soils formed in materials that accumulated at the base of the steeper slopes. Ernest soils have moderately slow permeability and a moderate available moisture capacity. The Allegheny soil series consists of deep, well-drained, loamy soils that formed in old sediments deposited by streams. These gently sloping soils are on high bottoms and terraces along rivers. Some of the terraces are several hundred feet above the streams. Allegheny soils have moderate permeability and moderate available moisture capacity (USDA - NRCS, 1977).

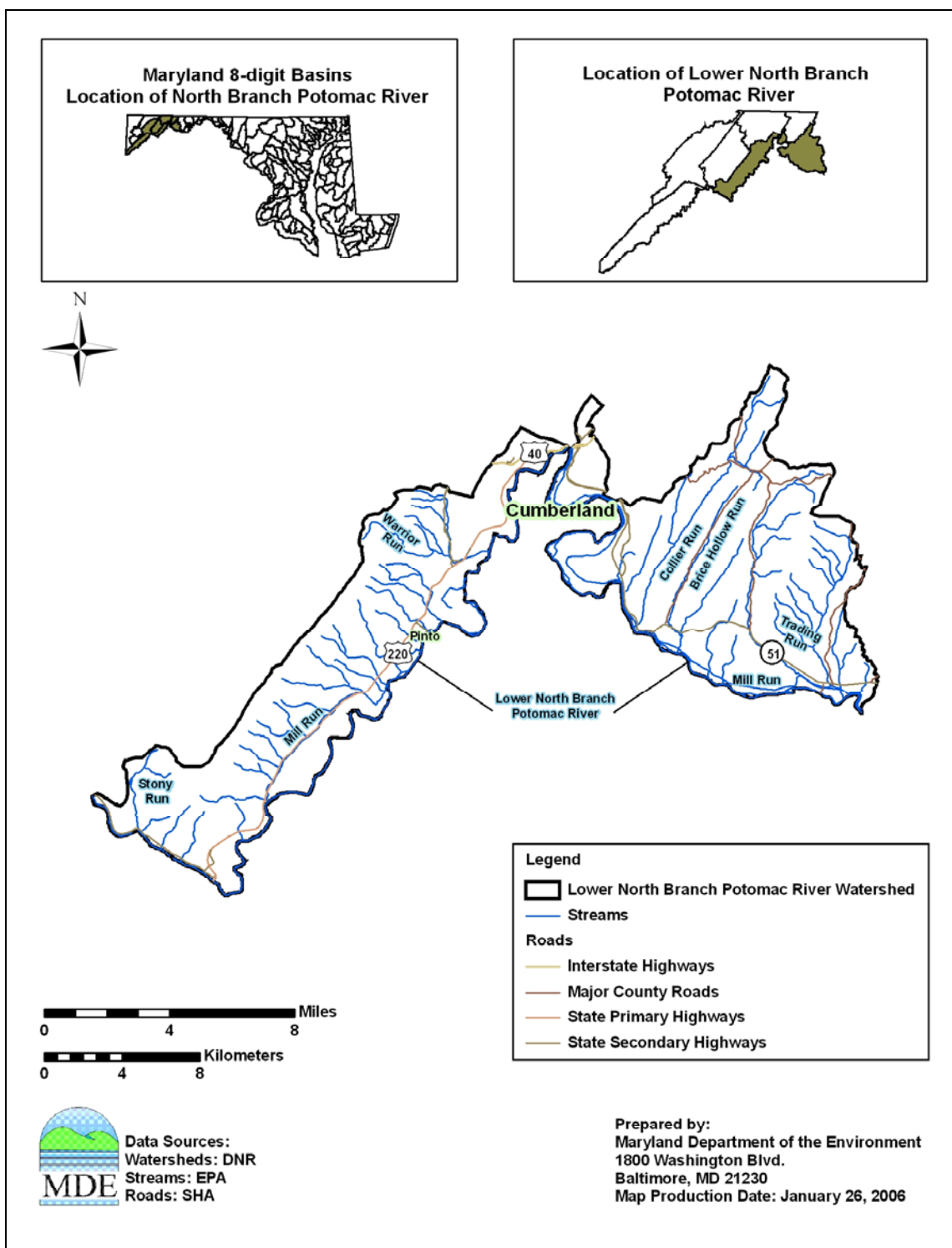


Figure 1: Location Map of the Lower North Branch Potomac River Watershed

2.1.1. Land Use

Land Use Methodology

The land use framework used to develop this TMDL was originally developed for the Chesapeake Bay Program Phase V (CBP P5) watershed model.¹ The CBP P5 land use Geographic Information System (GIS) framework was based on two distinct layers of development. The first GIS layer was developed by the Regional Earth Science Applications Center (RESAC) at the University of Maryland and was based on satellite imagery (Landsat 7-Enhance Thematic Mapper (ETM) and 5-Thematic Mapper (TM)) (Goetz *et al.*, 2004). This layer did not provide the required level of accuracy, especially important when developing the agricultural land uses. In order to develop accurate agricultural land use calculations, the CBP P5 used county level U.S. Agricultural Census data as a second layer (USDA, 1982, 1987, 1992, 1997 and 2002).

Given that land cover classifications based on satellite imagery are likely to be least accurate at edges (*i.e.*, boundaries between covers), the RESAC land uses bordering agricultural areas were analyzed separately. If the agricultural census data accounted for more agricultural use than the RESAC's data, appropriate acres were added to agricultural land from non-agricultural land uses. Similarly, if census agricultural land estimates were smaller than RESAC's, appropriate acres were added to non-agricultural land uses.

Adjustments were also made to the RESAC land cover to determine developed land uses. RESAC land cover was originally based on the United States Geological Survey (USGS) protocols used to develop the 2000 National Land Cover Database. The only difference between the RESAC and USGS approaches was that RESAC used town boundaries and road densities to determine urban land covered by trees or grasses. This approach greatly improved the accuracy of the identified urban land uses, but led to the misclassification of some land adjacent to roads and highways as developed land. This was corrected by subsequent analysis. To ensure that the model accurately represented development over the simulation period, post-processing techniques that reflected changes in urban land use have been applied.

The result of this approach is that CBP P5 land use does not exist in a single GIS coverage; instead, it is only available in a tabular format. The CBP P5 watershed model is comprised of twenty-five land uses. Most of these land uses are differentiated only by their nitrogen and phosphorus loading rates. The land uses are divided into fourteen classes with distinct sediment erosion rates. Table 1 lists the Phase V generalized land uses and detailed land uses classified by their erosion rates. Table 1 also lists the acres of each land use in the Lower North Branch Potomac River eight-digit watershed. Details of the land use development methodology have been summarized in the report entitled

¹ The EPA Chesapeake Bay Program developed the first watershed model in 1982. There have been many upgrades since the first phase of this model. The CBP P5 was developed to estimate flow, nutrient, and sediment loads to the Bay.

“Chesapeake Bay Phase V Community Watershed Model: Tracking Nutrient and Sediment Loads on a Regional and Local Scale” (USEPA – CBP, 2006b).

Lower North Branch Potomac River Watershed Land Use Distribution

The predominant land use is forest (74%), with the remaining land use classified as urban/developed (16%), crop/pasture (10%), and extractive (2%). A land use map is provided in Figure 2, and a summary of the watershed land use areas is presented in Table 1.

Table 1: Land Use Percentage Distribution for the Lower North Branch Potomac River Watershed

General Land Use	Detailed Land Use	Area (Acres)	Percent	Grouped Percent of Total
Crop	Animal Feeding Operations	4.1	0.0	4.3
	Hay	2,902.8	4.0	
	High Till	64.8	0.1	
	Low Till	67.7	0.1	
	Nursery	97.4	0.1	
Extractive	Extractive	57.3	0.1	0.1
Forest	Forest	52,973.0	73.2	73.9
	Harvested Forest	535.1	0.7	
Pasture	Natural Grass	27.3	0.0	5.2
	Pasture	3,750.3	5.2	
	Trampled Pasture	19.6	0.0	
Urban	Urban: Barren	95.6	0.1	16.4
	Urban: Imp	1,764.2	2.4	
	Urban: perv	10,033.9	13.9	
	Total	72,393.2	100.0	100.0

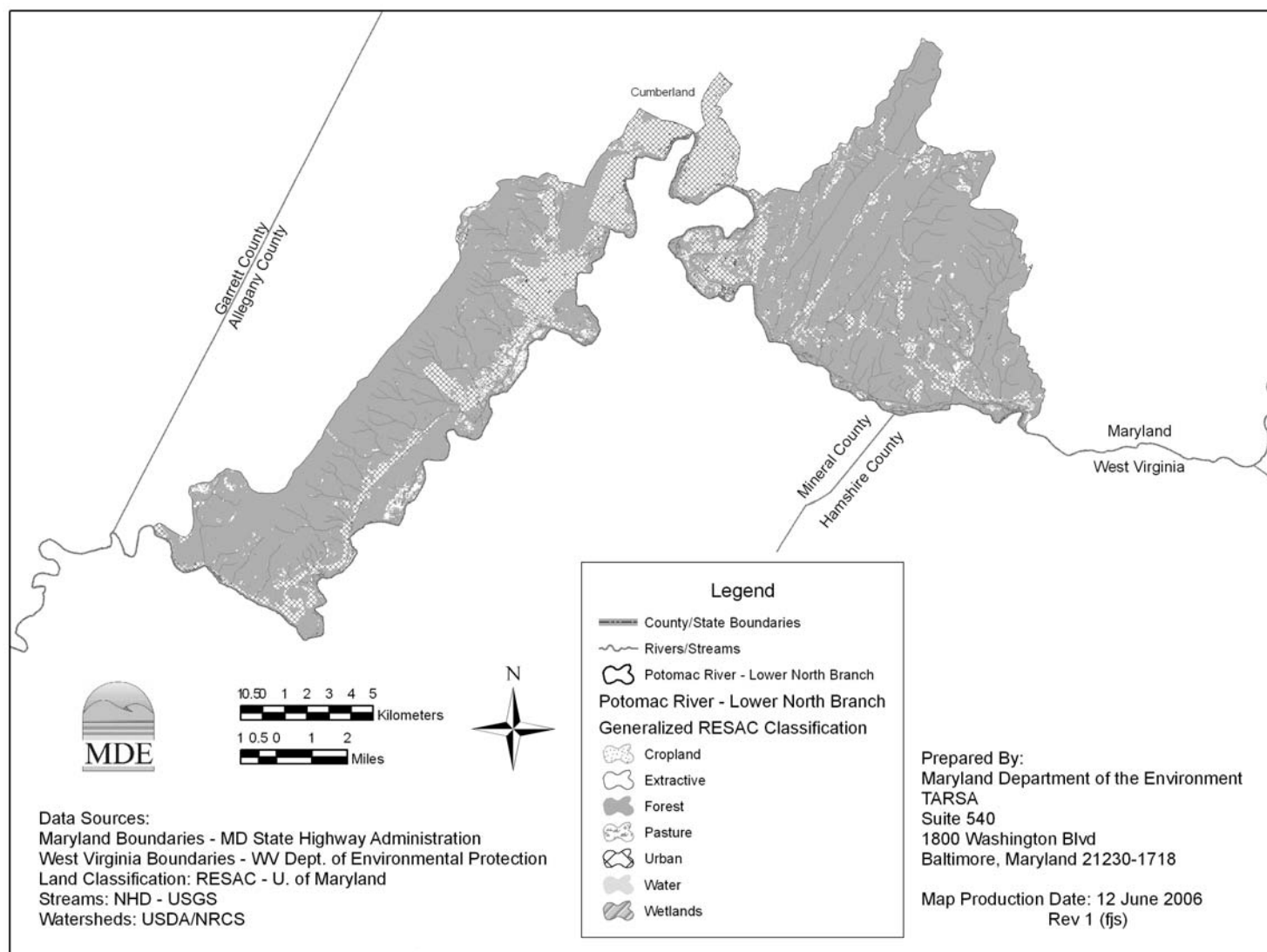


Figure 2: Land Use of the Lower North Branch Potomac River Watershed

2.2 Source Assessment

2.2.1 Nonpoint Sources (NPS)

General load estimation methodology

Nonpoint source sediment loads in the Lower North Branch Potomac River watershed are estimated based on the *edge-of-stream (EOS) calibration target loading rates* from the CBP P5 model. This approach is based on the fact that not all of the *edge-of-field (EOF)* sediment load is delivered to the stream or river (some of it is stored on fields down slope, at the foot of hillsides, or in smaller rivers or streams that are not represented in the model). To calculate the actual EOS loads, a *sediment delivery ratio* (the ratio of sediment reaching a basin outlet compared to the total erosion within the basin) is used. Details of the methods used to calculate sediment load are summarized in the report “Chesapeake Bay Phase V Community Watershed Model: Tracking Nutrient and Sediment Loads on a Regional and Local Scale” (USEPA – CBP, 2006b).

Edge-of-Field Target Erosion Rate Methodology

EOF target erosion rates for agricultural land uses and forest were based on erosion rates determined by the National Resource Inventory (NRI). NRI is a statistical survey of land use and natural resource conditions conducted by the Natural Resources Conservation Service (NRCS) (USDA – NRCS, 2006). Sampling methodology is explained by Nusser and Goebel (1997).

Estimates of average annual erosion rates for pasture and cropland are available on a county basis at five-year intervals, starting in 1982. Erosion rates for other land uses are not available on a county basis from NRI; however, for the purpose of the CBP Phase 2 watershed model, NRI calculated average annual erosion rates for forest land use on a watershed basis. These rates are still being used as targets in the Phase V model.

The average value of the 1982 and 1987 surveys was used as the basis for EOF target loads. Erosion rates from this period do not reflect best management practices (BMPs) or other soil conservation policies introduced in the wake of the effort to restore the Chesapeake Bay.

Lower North Branch Potomac River Watershed EOF Erosion Rates

Table 2 lists the average of the 1982 and 1987 erosion rates for pasture and cropland by county and also provides the NRI estimate of forest erosion rates for each county based on the Phase 2 segmentation. Rates for urban pervious, urban impervious, and barren land were based on a combination of best professional judgment, literature analysis, and regression analysis.

Table 2: Summary of EOF Erosion Rate Calculations

Land Use	Data Source	Allegany County (tons/acre/year)
Forest	Phase 2 NRI	0.13
Harvested Forest ¹	Average Phase 2 NRI (x 10)	3.0
Natural Grass	Average NR Pasture (1982-1987)	1.5
Pasture	Pasture NRI (1982-1987)	0.23
Trampled pasture ²	Pasture NRI (x 9.5)	2.19
Animal Feeding Operations ²	Pasture NRI (x 9.5)	2.19
Hay ²	Crop NRI (1982-1987) (x 0.32)	1.04
High Till Without Manure ²	Crop NRI (1982-1987) (x 1.25)	4.08
High Till With manure ²	Crop NRI (1982-1987) (x 1.25)	4.08
Low till With Manure ²	Crop NRI (1982-1987) (x 0.75)	2.45
Pervious Urban	Intercept Regression Analysis	0.74
Extractive	Best professional judgment	10
Barren	Literature survey	12.5 (w/ S&E ³ Controls) 25 (w/o S&E Controls)
Impervious	100% Impervious Regression Analysis	5.18

¹ Average based on Chesapeake Bay Basin NRI values

² NRI score data adjusted based on land use

³ sediment and erosion

Sediment Delivery Ratio: The base formula for calculating sediment delivery ratios in the CBP P5 model is the same as the formula used by the NRCS (USDA-NRCS, 1983):

$$DF = 0.417762 * A^{-0.134958} - 0.127097 \quad (\text{Equation 2.1})$$

where

DF (delivery factor) = sediment delivery ratio

A = drainage area in square miles.

In order to account for the differences in sediment loads due to distance traveled to the stream, CBP P5 model uses the sediment delivery ratio. Land cover specific sediment delivery ratios were calculated for each river segment using the following procedure:

- (1) Mean distance of each land use and the river reach was calculated;
- (2) Sediment delivery ratios for each land use were calculated (drainage area in Equation 2.1 was assumed to be equal to the area of a circle with radius equal to the mean distance between the land use and the river reach).

Edge-of-Stream Loads

EOS loads are the loads that actually enter the river reaches (*i.e.*, the mainstem of a watershed). Such loads represent not only the erosion from the land but all of the intervening processes of deposition on hillsides and sediment transport through smaller rivers and streams.

Table 3 lists the current overall solids budget for the Lower North Branch Potomac River watershed. It is broken down into nonpoint and point source loadings. The largest portion of the nonpoint source sediment loads is from urban land use. Forest land use is the next largest sediment contributor. The third largest contributor is crop land use, where the majority of the sediment is from land with hay. The remainder of the nonpoint source sediment load is from pasture.

2.2.2 Point Sources (PS)

A list of 21 active permitted sources in the Lower North Branch Potomac River watershed was compiled using MDE's Environmental Permit Service Center (EPSC) database. The types of permits identified were municipal surface discharges, industrial surface discharges, general mining, and general industrial stormwater. Permit information for municipal and industrial surface discharges was obtained from EPA's Permit Compliance System (PCS) database. Specifically, total suspended solids (TSS) permit limits and Discharge Monitoring Report (DMR) data (TSS and flow) were obtained. Permit information for mining and industrial stormwater permits was obtained from MDE permit files. Specifically, site areas, TSS permit limits, and average flow data were obtained. The total permitted TSS loading for the Lower North Branch Potomac River is 5.2 tons/yr.

2.2.3 Overall Solids Budget

Table 3 presents the current overall solids budget for the Lower North Branch Potomac River Watershed.

Table 3: Current Solids¹ Budget for the Lower North Branch Potomac River Watershed

General Land Use	Description	Load (Ton/Yr)	Percent	Grouped Percent of Total
Crop	Animal Feeding Operations	2.2	0.0	10.0
	Hay	604.8	8.2	
	High Till	53.0	0.7	
	Low Till	33.2	0.5	
	Nursery	42.7	0.6	
Extractive	Extractive	103.9	1.4	1.4
Forest	Forest	1,154.6	15.7	19.3
	Harvested Forest	269.1	3.7	
Pasture	Natural Grass	17.8	0.2	6.0
	Pasture	403.8	5.5	
	Trampled Pasture	20.1	0.3	
Urban	Urban: Barren	348.7	4.7	63.1
	Urban: Imp	2,471.0	33.6	
	Urban: perv	1,828.0	24.8	
	Sub-total	7353.0	99.9	99.9
Permits	Process Load (Mainstem)	10.7	0.1	0.1
	Process Load (Tributaries)			
	Total	7,363.7	100.0	100.0

¹ The word “solids” is used instead of “sediments” because the point source inputs are included.

2.3 Water Quality Characterization

The Lower North Branch Potomac River watershed was originally listed on Maryland’s 1996 303(d) List as impaired by elevated sediments from nonpoint sources, with supporting evidence cited in Maryland’s 1996 305(b) report. The 1996 305(b) report did not directly state that elevated sediments were a concern (MDE, 2006a and DNR, 1996).

To provide a water quality characterization of the Lower North Branch Potomac River watershed, it must first be determined how elevated sediment loads are linked to degraded stream water quality. It was outlined in the Maryland 2004 303(d) report, that degraded stream water quality resulting in a sediment impairment is characterized by erosional impacts, depositional impacts, and decreased water clarity (MDE, 2006b). For this analysis, cumulative erosional and depositional impacts were evaluated based on two site-specific water quality parameters – embeddedness and epifaunal substrate condition. Embeddedness is the fraction of surface area of larger particles surrounded by finer sediments, and epifaunal substrate is the amount and variety of hard, stable substrates used by benthic macroinvertebrates. In general, low embeddedness and high epifaunal substrate are beneficial to the aquatic life of a stream system. These parameters were collected by the Maryland Biological Stream Survey (MBSS) program (see Table 4, Figure 3, and Appendix A). Water clarity was evaluated by instantaneous turbidity samples, also collected by the MBSS program. In addition to the characterizations outlined in the Maryland 2004 303(d) report, sediment load was also used to characterize the watershed. Sediment load is a quantitative measure of the total sediment transported to the highest order stream draining the watershed. The sediment load is reported in Table 3 as an absolute value (ton/yr), and in this section as a factor beyond an all-forest (natural) condition.

Table 4: MBSS stations in the Lower North Branch Potomac River watershed

Site	Date Sampled	Latitude (dec degrees)	Longitude (dec degrees)
PRLN-104-R-2003	12JUN2003	39.54738	78.58555
PRLN-105-R-2003	12JUN2003	39.61061	78.60261
PRLN-107-R-2003	26JUN2003	39.54911	78.60098
PRLN-108-R-2003	07JUL2003	39.5775	78.70161
PRLN-109-R-2003	18JUN2003	39.49893	78.95916
PRLN-113-R-2003	18JUN2003	39.49678	78.95466
PRLN-115-R-2003	07AUG2003	39.56149	78.88312
PRLN-119-R-2003	18JUN2003	39.58448	78.86666
PRLN-120-R-2003	26JUN2003	39.59377	78.69249
PRLN-122-R-2003	07AUG2003	39.52757	78.93797
PRLN-201-R-2003	26JUN2003	39.54169	78.60175
PRLN-306-R-2003	07JUL2003	39.60372	78.70321
PRLN-316-R-2003	07JUL2003	39.59311	78.71361
PRLN-318-R-2003	20AUG2003	39.61314	78.69546
PRLN-321-R-2003	17JUL2003	39.51548	78.91448

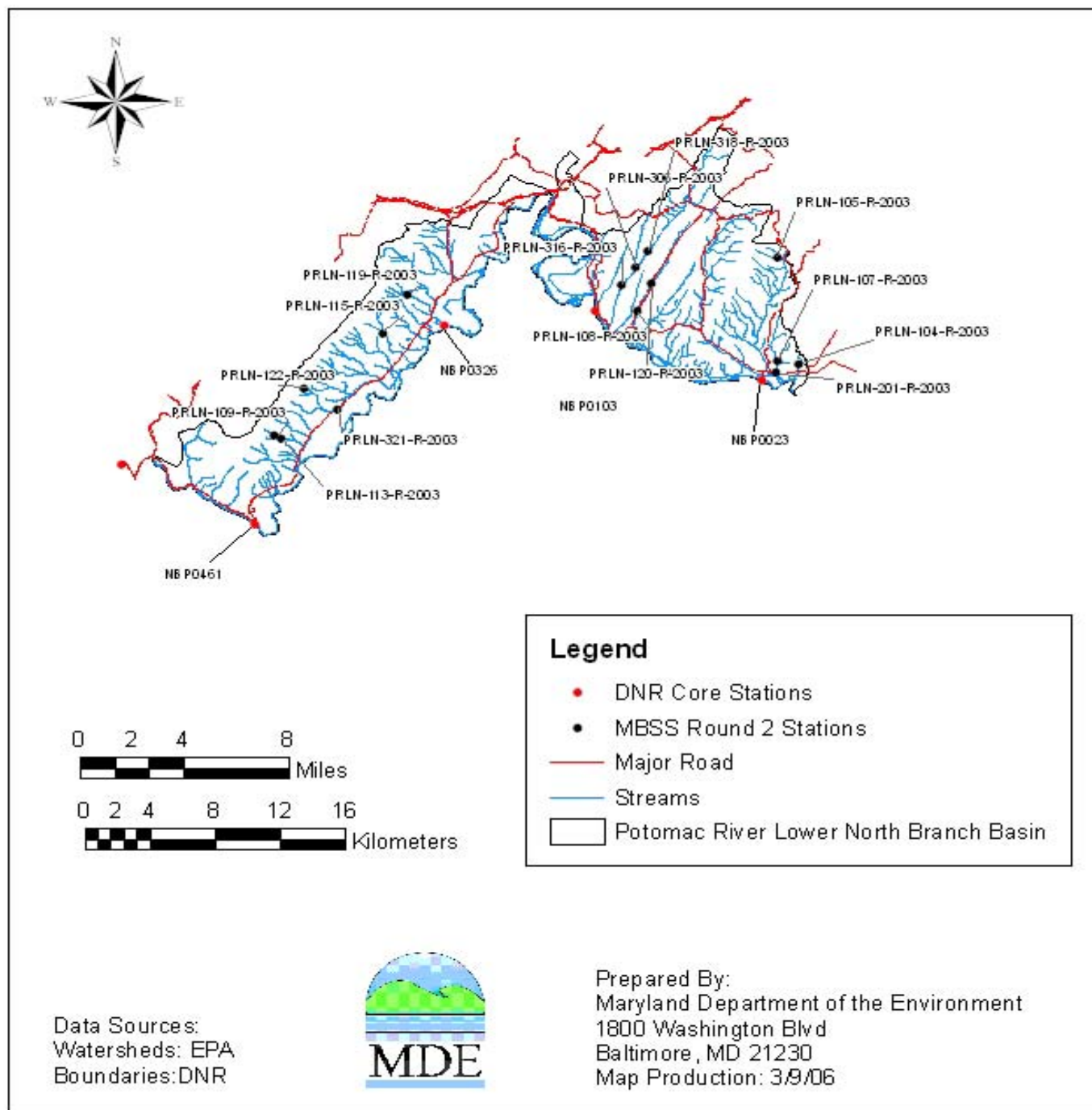


Figure 3: MBSS Stations in the Lower North Branch Potomac River watershed

Increasing embeddedness and decreasing epifaunal substrate condition scores indicate possible erosional or depositional impacts from elevated sediment loads. There are no numeric limits for embeddedness and epifaunal substrate condition. Instead, monitoring results were compared to values observed in streams identified as having a healthy benthic community (*i.e.*, reference sites). The benthic community was chosen for comparison because it is more directly impacted than are fish by the physical conditions of the streambed. Impacts or changes to the streambed could affect the benthic community by altering food quality, covering habitat, filling interstitial space and altering water movement (Minshall, 1984). A comparison of MBSS sampling results to reference sites is presented in the Figure 4, showing that the Lower North Branch Potomac River has slightly more impaired values than the reference group.

Reference sites for comparison were selected from the same physiographic region (Highland) and were required to have Benthic Index of Biotic Integrity (BIBI) scores significantly greater than 3.0 (based on a scale of 1 to 5). A threshold of 3.0 was selected because this is the level indicative of satisfactory water quality conditions, per Maryland's biocriteria requirements (see Roth *et al.*, 2000, Roth *et al.*, 1998 and Stribling *et al.*, 1998). In determining if the site score is significantly greater than 3.0, a default confidence interval was applied that is based on the coefficient of variation from replicate samples.

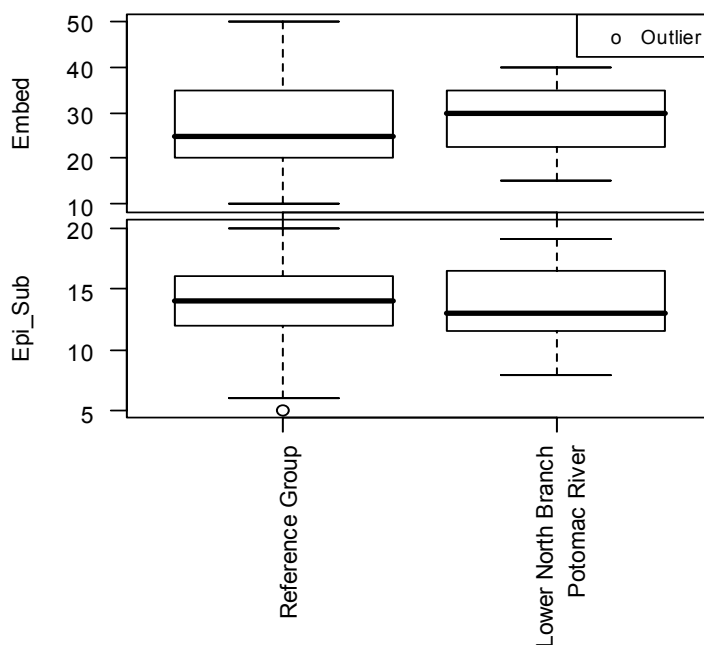


Figure 4: Lower North Branch Potomac River embeddedness and epifaunal substrate compared to reference sites

MBSS sampling also includes turbidity samples, which provide an instantaneous measure for evaluating water clarity. These samples were collected during the summer low flow

period and are only collected one time per site. Since the representativeness of these samples to the overall stream water quality is limited, they were not used in this analysis.

The average annual sediment load is the only currently available target that accounts for the potential effect of both water clarity and erosional/depositional impacts to the aquatic community. Thus, it will be used in this analysis as the final determining factor of sediment impairment. An elevated sediment load can be a result of increased TSS, which reduces water clarity. Further, an elevated sediment load can be a result of channel erosion. If the sediment load is beyond the transport capacity of the stream, then sedimentation is possible and could result in the filling of the streambed interstitial spaces.

The average annual watershed sediment load used in this analysis is an estimate from the CBP P5 model and provides a quantitative estimate of sediment to the highest order (largest) stream in the watershed. This is estimated for the rainfall driven sediment load, which is the most significant sediment source in a non-tidal watershed.

Three watershed-loading scenarios were conducted in order to evaluate the water quality of the mainstem (before and after implementation of upstream TMDLs). First, the cumulative watershed load from all contributing upstream watersheds, including the Potomac River Lower North Branch, was estimated. The second scenario estimated the cumulative watershed load assuming implementation of TMDLs under development in upstream basins. The third scenario estimated the load for the Maryland portion of the Lower North Branch Potomac River 8-digit watershed only. The purpose of the three loads was to evaluate the water quality of the mainstem (before and after implementation of upstream TMDLs) and the local water quality in the Maryland portion of the watershed. Table 5 lists the sediment loading estimates under all-forest conditions, current conditions, and after upstream TMDL implementation for all watersheds draining to the Potomac River Lower North Branch.

Table 5: Estimated Sediment Loads for the Potomac River Lower North Branch

Basin Number	Basin Name	All forest Load (Ton/yr)	Current Load (Ton/yr)	(1) Load after Upstream TMDL Allocation (Ton/yr)
2141001	Potomac River L N Branch	2,943.5	13,441.4	13,441.4
2141002	Evitts Creek	2,731.7	7,681.8	7,614.8
2141003	Wills Creek	4,350.1	11,276.9	10,926.8
2141004	Georges Creek	1,229.2	6,197.4	4,056.2
2141005	Potomac River U N Branch	3,997.3	20,785.5	19,144.6
2141006	Savage River	1,636.1	4,059.8	4,059.8
	Total	16,888.0	63,442.7	59,243.6
	Load/forest load	1.00	3.76	3.51

Since there are no established numeric limits for watershed sediment loads, the watershed sediment load in the Lower North Branch Potomac River watershed was compared to loads estimated in reference watersheds. Reference watersheds were determined based on the Benthic and/or Fish Index of Biotic Integrity (BIBI/FIBI) average watershed scores significantly greater than 3.0 (based on a scale of 1 to 5). A threshold of 3.0 was selected because this is the level indicative of satisfactory water quality per Maryland's biocriteria (see Roth *et al.*, 2000; Roth *et al.*, 1998 and Stribling *et al.*, 1998). In determining if the average watershed score is significantly greater than 3.0, a 90% confidence interval was calculated for each watershed based on the individual MBSS sampling results.

Comparison of watershed sediment loads to loads from reference watersheds requires that the watersheds be similar in physical and hydrological characteristics. To satisfy this requirement, reference watersheds were selected only from the Highland and Piedmont physiographic regions. This region is consistent with the non-coastal region that was identified in the 1998 development of FIBI and subsequently used in the development of the BIBI (Roth *et al.*, 1998 and Stribling *et al.*, 1998). To control for the variability in soil type, rainfall, and topography, individual watershed sediment loads were normalized to their all-forested condition sediment load. The normalization calculation divides the current watershed sediment load by the sediment load assuming an all-forested condition. This resulting factor, the normalized sediment load, describes the current sediment load beyond an all-forested condition.

A comparison of the three Lower North Branch Potomac River normalized sediment loads to the reference watershed normalized sediment loads is shown in Figure 5. The cumulative load from all upstream basins is listed as Potomac River LNB; the cumulative load assuming upstream TMDL implementation is Potomac River LNB (TMDL); and the load from the Maryland section only is listed as Potomac LNB (MD). Figure 5 shows that the all three of the Lower North Branch Potomac River normalized sediment loads are higher than the reference watershed normalized sediment load.

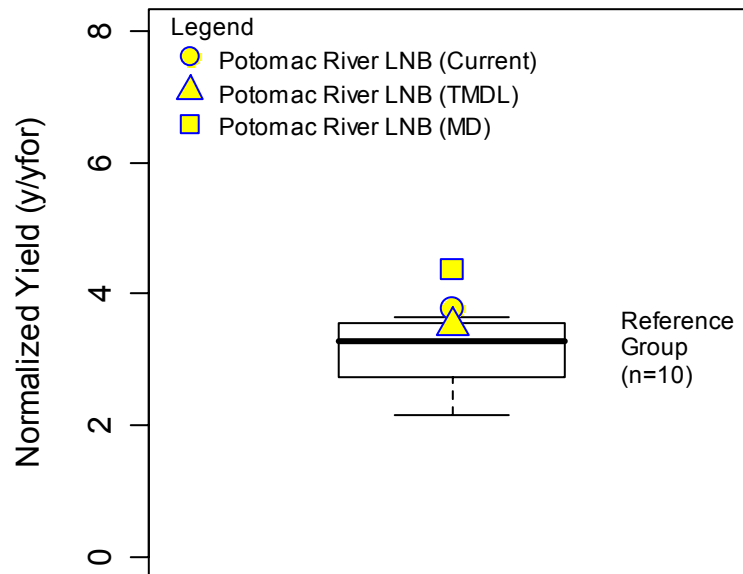


Figure 5: Lower North Branch Potomac River normalized sediment yield compared to reference watershed group

Finally, the distribution of land use for the Lower North Branch Potomac River watershed was compared to the reference watersheds and determined to be within the ranges found in the reference watersheds. A comparison of the Lower North Branch Potomac River land use to the range of reference watersheds land use is illustrated in Figure 6, showing that the land used of the Lower North Branch Potomac River is similar to that of the reference group.

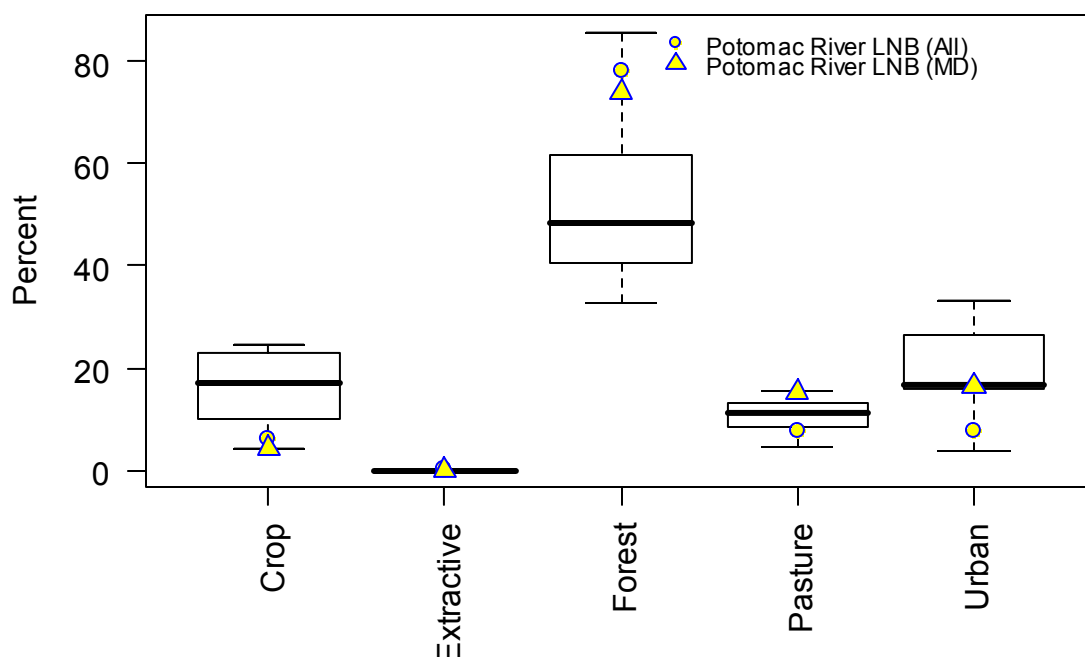


Figure 6: Lower North Branch Potomac River land use compared to reference watershed group

Potomac River Mainstem Stations

The Maryland Department of Natural Resources (DNR) Core/Trend program has monitoring information at five stations in the mainstem of the Potomac River Lower North Branch (see Table 6 and Figure 3 for details). Benthic macroinvertebrate data was collected for last 9 to 24 years. Summary information on the biotic index values, taxa numbers, diversity index, and the percent EPT (Ephemeroptera, Plecoptera and Tricoptera) was reported by DNR (DNR, 2006).

Table 6: DNR Core stations in the Upper North Branch Potomac River Watershed

Site Number	Site Name	Latitude (dec degrees)	Longitude (dec degrees)
NBP0023	Oldtown	39.53704	-78.6111
NBP0103	Blue Springs	39.57703	-78.7314
NBP0326	Pinto	39.56676	-78.8389
NBP0461	Route 220/Keyser	39.44482	-78.9717
NBP0528	Piedmont	not reported	not reported

Statistical analysis of the long term Core/Trend data indicates a significant improvement in water quality in at least one parameter at all stations. The Oldtown station showed a significant change in the biotic index since 1976 and is now in the upper fair range and water quality is classified as fair to good. The Blue Springs site showed a significant change in three parameters since 1976. The taxa number and biotic index increased, while the EPT decreased. Water quality at Blue Springs is classified as fair to good. The Pinto site showed a significant improvement in both the taxa numbers and biotic index values since 1976. Water quality at the Pinto station is classified as fair to good. The Keyser site showed a significant improvement in taxa numbers, going from the poor to good range, since 1977. Water quality is classified as fair with slight improvement over time. The Piedmont site showed a significant trend in taxa number, going from fair to very good, since 1991. Water quality at the Piedmont site is reported as fair to good with slight improvement over time. In summary, all sites showed improvement in water quality and four sites are classified as having fair to good water quality with one site (Keyser) having fair water quality (DNR, 2006).

2.4 Water Quality Impairment

The Maryland water quality standards Surface Water Use Designation for the Lower North Branch Potomac River watershed is Use I (Water Contact Recreation and Protection of Aquatic Life) (COMAR, 2006a). The water quality impairment of the Lower North Branch Potomac River watershed addressed by this TMDL consists of an elevated sediment load beyond a level to support aquatic life.

Because the south shore of the Lower North Branch Potomac River mainstem acts as a state boundary between Maryland and West Virginia, the first stage of the analysis was to evaluate the mainstem. The mainstem was evaluated using biological information from the mainstem stations collected by the DNR Core/Trend program and the sediment load estimate from the CBP P5 watershed model. This analysis was used to determine if sediment loads from upstream sources were causing a water quality impairment to the mainstem. The second stage of the analysis was to identify whether or not the water quality in the Maryland tributaries draining to the Potomac River Lower North Branch is impaired by sediment.

Biological results from both the DNR Core/Trend stations located on the mainstem indicate that the water quality can be classified as fair to good, with slightly improving water quality. The current sediment load divided by the all-forest load, referred to as the normalized sediment load, is approximately 3.75 based on current conditions. Accounting for reductions from upstream TMDLs that are currently being developed would reduce the normalized sediment load to approximately 3.5. The limiting sediment load was estimated using reference watersheds, where the assimilative capacity is estimated as the median of the normalized reference load, approximately 3.3. Additionally, the upper quartile of the reference watersheds' normalized sediment loads is 3.6, which allows for a margin of safety. These values are representative for

watersheds in the Highland and Piedmont physiographic regions with land use distributions within the range of the reference watersheds. Without upstream sediment reductions, the overall Lower North Branch Potomac Watershed just exceeds the upper quartile of the reference watersheds. While it might be classified as slightly impaired (or near the borderline of impairment), it is important to note that mainstem stations exhibit an improving trend in water quality. Accounting for reduction from upstream TMDLs currently under development, the mainstem would not be classified as impaired, as the normalized load falls within the range of loads defining the Margin of Safety. Further details can be found in Tables A-1 for reference watersheds and A-4 for the Lower North Branch Potomac River.

Assessment of the local Maryland tributaries draining to the mainstem indicates that there is a sediment impairment based on an estimated normalized sediment load of 4.38 times the all-forest condition. However, embeddedness and epifaunal substrate scores from the MBSS do not indicate a significant deviation from reference sites. Upon further evaluation of the MBSS site locations, it was determined that many of the sites are located upstream of the potential sediment source, the urban land use. It was concluded that based on the normalized sediment load, the Maryland tributaries draining to the mainstem of the Lower North Branch Potomac River are likely impaired by elevated sediment loads.

Maryland's general water quality criteria prohibit pollution of waters of the State by any material in amounts sufficient to create nuisance or interfere with designated uses (COMAR, 2006b). This analysis indicates that sediment loads exceed levels that support aquatic health in the Maryland tributaries draining to the Potomac mainstem. It also indicates that the mainstem is likely impaired, but with upstream improvements and increasing trends in water quality, it will likely attain aquatic health standards. As a result, this TMDL will determine sediment loads and reductions to Maryland tributaries draining to the Potomac mainstem that will meet local water quality in lower order (smaller) streams.

3.0 TARGETED WATER QUALITY GOAL

The objective of the sediment TMDL established in this document is to ensure that the sediment loads and resulting effects are at a level to support the Use I designations for the Lower North Branch Potomac River watershed, and more specifically at a level to support aquatic health.

4.0 TOTAL MAXIMUM DAILY LOADS AND SOURCE ALLOCATION

4.1 Overview

This section describes how the sediment TMDLs and load allocations were developed for the Lower North Branch Potomac River watershed. Section 4.2 describes the analysis framework for estimating sediment loading rates, and the assimilative capacity of the watershed stream system. Section 4.3 summarizes the scenarios that were used in the analysis and the results. Section 4.4 discusses critical conditions and seasonality. Section 4.5 explains the calculations of TMDL loading caps. Section 4.6 details the load allocations between point and nonpoint sources and Section 4.7 explains the rationale for the margin of safety. Finally, Section 4.8 summarizes the TMDL.

4.2 Analysis Framework

The computational framework chosen for the Lower North Branch Potomac River TMDL was the CBP P5 watershed model. The EOS sediment load is calculated per each land use as a product of the land use area, land use target loading rate, and loss from the EOF to the main channel. The sediment delivery ratio is used because not all of the EOF sediment load is delivered to the stream or river. Some of it is stored on fields down slope, at the foot of hillsides, or in smaller rivers or streams that are not represented in the model. The sediment delivery ratio is the ratio of the sediment load reaching a basin outlet compared to the total erosion within the basin.

The spatial domain of the watershed model segmentation aggregates to the Maryland 8-digit watersheds. The Lower North Branch Potomac River watershed is represented by four CBP P5 model segments. However, the proximity of specific land cover to that of the main channel is captured through the sediment delivery ratio. Details of the data sources for the unit loading rates can be found in Section 2.2 of this report, and complete details of the modeling approach will be included in the report titled “Chesapeake Bay Phase V Community Watershed Model: Tracking Nutrient and Sediment Loads on a Regional and Local Scale” (USEPA-CBP, 2006b). Predicted sediment loads are based on CBP P5 2002 land use, and represent a long-term average loading rate.

To reduce the variability when comparing watersheds within and across regions, the watershed sediment yield is normalized by a constant background condition. A similar approach was used by EPA Region IX in sediment TMDLs in California (Navarro River, Trinity River), where the loading capacity was based on an analysis of the amount of human-caused sediment delivery that can occur in addition to natural sediment delivery without causing adverse impacts to aquatic life. The normalized sediment yield for this TMDL is calculated as the watershed sediment yield divided by the forest sediment yield. This new term, defined as Y_n , represents the current watershed sediment load compared to that of an all-forested condition. The equation is as follows:

$$Y_n = \frac{y_{ws}}{y_{for}} \quad (\text{Equation 4.1})$$

where

Y_n = ratio of watershed sediment yield to all-forest watershed sediment yield

y_{ws} = watershed sediment yield (Ton/Ac/Yr)

Y_{for} = forest land use sediment yield (Ton/Ac/Yr)

4.3 Scenario Descriptions and Results

The following analyses allow a comparison of baseline conditions (under which water quality problems exist) to a future condition that calculates the maximum average annual sediment load allowable that supports the stream's designated use. The analyses are grouped according to *baseline conditions* and *future conditions* associated with TMDLs.

Baseline Conditions

The baseline conditions are intended to provide a point of reference by which to compare the future scenario that simulates conditions of a TMDL. The baseline conditions typically reflect an approximation of nonpoint source loads during the monitoring time frame, as well as estimated point source loads based on discharge data for the same period.

The Lower North Branch Potomac River watershed baseline sediment loads are estimated using the CBP P5 target EOF land use sediment loading rates with the CBP 2002 land use. Watershed loading calculations based on the CBP P5 segmentation scheme watersheds are represented by four model segments in the Lower North Branch Potomac River watershed. The sediment loads from the permitted sources are estimated using the permit information. Details of these loading source estimates can be found in Section 2.2 of this report.

The total sediment load from the Maryland 8-digit Lower North Branch Potomac River watershed is 7,363.7 tons per year.

Future (TMDL) Conditions

This scenario represents the future conditions of maximum allowable sediment loads that will support a healthy biological community. In the TMDL calculation, the allowable load for the impaired watershed is calculated as the product of the normalized reference sediment yield (determined from watersheds with a healthy benthic community), the Lower North Branch Potomac River forest sediment yield, and the Lower North Branch Potomac River watershed area (for details see Section 2.3). This load is considered the

maximum allowable load the watershed can assimilate and still attain water quality standards.

The TMDL loading and associated reductions are averaged at the Maryland 8-digit watershed scale, which is consistent with the original listing scale. It is important to recognize that some subwatersheds may require higher reductions than others, depending on the distribution of the land use.

The formula for estimating the TMDL is as follows:

$$TMDL = Yn_{ref} \cdot y_{forest} \cdot A_{ws} \quad (\text{Equation 4.2})$$

where

TMDL = allowable load for impaired watershed (Ton/Yr)

Yn_{ref} = normalized reference watershed yield (3.3)

y_{forest} = forest sediment yield from impaired watershed (Ton/Ac/Yr)

A_{ws} = area of impaired watershed (Ac)

i = CBP P5 model segment

n = number of CBP P5 model segments in watershed

4.4 Critical Condition and Seasonality

EPA regulations require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters (CFR, 2006). The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when it is most vulnerable. The biological monitoring data used to determine the reference watersheds integrates the stress effects over the course of time and thus inherently addresses critical conditions. Seasonality is captured in two respects. First, it is captured through the use of the biological monitoring data. Second, the MBSS sampling included benthic sampling collected in the spring and fish sampling collected in the summer. While fish results were not directly applied in the final analysis, Currey *et al.* (2006) reported that there was minimal difference in the normalized sediment yields for the reference group watersheds using benthic scores only and the group using both fish and benthic scores. Thus, this analysis has captured both spring and summer flow conditions.

4.5 TMDL Loading Caps

This section presents the TMDL of TSS for the Lower North Branch Potomac River watershed. This load is considered the maximum allowable load the watershed can assimilate and still attain water quality standards. This load is a long-term average.

The sediment TMDL for the Lower North Branch Potomac River watershed, based on Equation 4.2, is as follows:

$$\text{TMDL} = 5,553.6 \text{ Tons/yr}$$

4.6 Load Allocations Between Point and Nonpoint Sources

The allocations described in this section demonstrate how the TMDL of TSS can be implemented to meet the water quality criteria in the Lower North Branch Potomac River watershed. The State reserves the right to revise these allocations provided the revisions are consistent with achieving water quality standards.

The waste load allocation (WLA) represents the TSS load from permitted sources within the watershed. It includes NPDES-regulated municipal wastewater treatment plant discharges, process industrial wastewater treatment plant discharges, and process water from mining activities.

The watershed model nonpoint source loads capture rainfall-generated sediment loads from nonpoint source runoff. Loads related to process water are added to the nonpoint source loads estimated from the watershed model to estimate the total sediment/solids load to the stream system. The wastewater and industrial process water loads are estimated using permitted flows and TSS limits where available. If TSS limits are not specified, then TSS concentrations are estimated on a case-by-case basis.

There are a total of 21 permitted surface water discharge activities in the Lower North Branch Potomac River watershed. These include nine municipal permits, five industrial permits, one general permit related to mining activities, and six industrial stormwater permits. These sources combine to produce a total permitted TSS load of 5.2 tons/yr. Since this analysis does not include the Potomac mainstem, only permitted sources in upstream Maryland tributaries within the Potomac Lower North Branch 8-digit watershed will be considered.

Nonpoint source urban stormwater sediment load is assigned to either the WLA or Load Allocation (LA), based on the existence of Phase I or Phase II Municipal Separate Storm Sewer permits in the watershed. EPA NPDES regulations on Phase I of NPDES require that “large” (populations greater than 250,000) and “medium” (populations greater than 100,000) municipalities establish and maintain comprehensive programs to reduce storm

drain system pollution. Phase II municipal stormwater regulations followed in 1999 and established obligations for small storm drain systems within urbanized areas not covered previously. As part of the six minimum control measures specified in EPA's Phase II regulations (and also included as management programs in Phase I permits), jurisdictions must incorporate public education, public participation, illicit discharge detection and elimination, construction site runoff control, post construction runoff control and pollution prevention. Therefore, in areas with MS4 permits, sediment loads from pervious urban, impervious urban, and construction areas are included in the WLA. Likewise, in areas with no MS4 permits, sediment loads from these areas will be included in the LA.

Load allocations have been made to include nonpoint source sediment loads from agricultural activities, urban (developed) land, extractive land and forest. Agricultural activities include various cropland, pasture and feeding operations. Developed land includes both pervious urban, impervious urban, and construction areas. Extractive land use is comprised of active and unclaimed mines, gravel pits, etc. Forest land use includes both natural undisturbed woodland areas and harvested forest lands.

In this watershed, forest is the only non-controllable source, as it represents the most natural condition in the watershed. No reductions were applied to permitted sources because at 0.1% of the total load, such controls would produce no discernable water quality benefit. Reductions are estimated for the predominant controllable sources (i.e., significant contributors of sediment to the stream system). If only these predominant (generally the largest) sources are controlled, water quality standards can be achieved in the most effective and efficient manner. Predominant sources generally include urban land, high till crops, low till crops, hay, pasture, and harvested forest, but additional sources can be added and controlled until the water quality standard is attained. A reduction of 25% from current estimated loads will be required to meet TMDL allocation and attain water quality standards. Table 7 summarizes the TMDL scenario results based on applying the 25% reduction equally to the predominant controllable sediment sources. The reductions in Table 7 are based on multiple sources (e.g. high till, low till, hay, animal feeding operations, and nursery all equal a crop source) and reflect that reductions were only applied to the predominant source categories (e.g. high till).

Table 7: Point Source and Nonpoint Source Load Allocations

Source	Baseline Load (Ton/Yr)	TMDL Scenario Load (Ton/Yr)	Reduction
Crop	735.9	553.9	24.7%
Extractive	103.9	103.9	0.0%
Forest	1,423.8	1,342.4	5.7%
Pasture	441.7	319.8	27.6%
Urban	4,647.7	3,222.9	30.7%
Permitted	10.7	10.7	
Total	7,363.7	5,553.6	24.6%

*based on permit limits

4.7 Margin of Safety

All TMDLs must include a margin of safety (MOS) to account for any lack of knowledge and uncertainty concerning the relationship between loads and water quality (CWA, 2006). It is proposed that the estimated variability around the reference watershed group used in this analysis already accounts for such uncertainty. Analysis of the reference group yields indicates that approximately 75% of the reference watersheds have a normalized reference yield less than 3.6, while 50% of the normalized yields are less than 3.3. The reference yield was set at the median value of 3.3. This is considered an environmentally conservative estimate, since 50% of the reference watersheds have a normalized sediment yield above this value. This reference yield results in an implicit margin of safety of approximately 8%.

Additional sediment reductions will also occur in the Potomac mainstem as a result of this TMDL (Maryland tributaries draining to the mainstem). Further analysis indicates that including the reductions from this TMDL and upstream sediment TMDLs, the normalized sediment load to the Potomac mainstem Lower North Branch would be approximately 3.4 times the all-forest conditions. This is within the typical MOS incorporated in Maryland's non-tidal sediment TMDLs.

4.8 Summary of Total Maximum Daily Loads

The long-term average annual TMDL allocation for the Maryland 8-digit Lower North Branch Potomac River is summarized in Table 8. A long-term daily limit is presented in Table 9, which is only applicable during baseflow conditions.

Table 8: Annual TMDL Allocation Summary

	TMDL (Ton/yr)	LA	WLA	MOS
Maryland	5,553.6	5,542.9	10.7	Implicit

Table 9: Long Term Daily TMDL Allocation Summary

	TMDL (lb/day)
Maryland	30,430.7

5.0 ASSURANCE OF IMPLEMENTATION

This section provides the basis for reasonable assurances that the sediment TMDL will be achieved and maintained. Section 303(d) of the Clean Water Act and current EPA regulations require reasonable assurance that the TMDL load and wasteload allocations can and will be implemented. Maryland has several well-established programs to draw upon, including the Water Quality Improvement Act of 1998 (WQIA) and the Federal Nonpoint Source Management Program (§ 319 of the Clean Water Act).

Potential funding sources for implementation include the Buffer Incentive Program (BIP). Other funding available for local governments include the State Water Quality Revolving Loan Fund and the Stormwater Pollution Cost Share Program. Details of these programs and additional funding sources can be found at <http://www.dnr.state.md.us/bay/services/summaries.html>.

Potential best management practices for reducing sediment loads and resulting impacts can be summarized in three general categories. The first is directed toward agricultural lands, the second to urban (developed) land, and the third applies to all land uses.

In agricultural areas, comprehensive soil conservation plans can be developed that meet criteria of the USDA-NRCS Field Office Technical Guide (USDA-NRCS, 1983). Soil conservation plans help control erosion by modifying cultural practices or structural practices. Cultural practices may change from year to year and include changes to crop rotations, tillage practices, or use of cover crops. Structural practices are longer-term measures that include, but are not limited to the installation of grass waterways (in areas with concentrated flow), terraces, diversions, sediment basins, or drop structures. The reduction percentage attributed to cultural practices is determined based on changes in land use, while structural practices can have reduction percentages up to 25%. In addition livestock can be controlled via stream fencing and rotational grazing. Sediment reduction efficiencies of methods applicable to pastureland use range from about 40% to 75% (USEPA-CBP, 2004).

Sediment from urban areas can be reduced by stormwater retrofits, impervious surface reduction, and stream restoration. Stormwater retrofits include modification of existing stormwater structural practices to address water quality. Reductions range from as low as 10% for dry detention to approximately 80% for wet ponds, wetlands, infiltration practices and filtering practices. Impervious surface reduction results in a change in hydrology that could reduce stream erosion (USEPA – CBP, 2003).

All non-forested land uses can benefit from improved riparian buffer systems. A riparian buffer reduces the effects of upland sediment sources through trapping and filtering. Riparian buffer efficiencies vary depending on type (grass or forested), land use (urban or agriculture) and physiographic region. The CBP estimates riparian buffer sediment reduction efficiencies in the Lower North Branch Potomac River region to be approximately 50% (USEPA, 2006a).

DRAFT

In summary, the use of the aforementioned funding mechanisms and best management practices provides reasonable assurance that this TMDL can be implemented.

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APPENDIX A

Table A-1: Reference watersheds for clusters one through three

MD 8-digit Name	Cluster	MD 8-digit	FIBI n	BIBI n	FIBI	BIBI	Normalized ² Yield (y/yfor)	Yield ² (Ton/ac/yr)
Deer Creek	3	2120202	28	28	Ind.	Pass	3.63	0.27
Broad Creek	3	2120205	10	10	Ind.	Pass	3.67	0.30
Little Gunpowder Falls	3	2130804	19	20	Ind.	Pass	3.26	0.35
Prettyboy Reservoir	3	2130806	11	11	Pass	Pass	2.87	0.24
Liberty Reservoir	3	2130907	31	31	Pass	Pass	3.28	0.18
S Branch Patapsco	3	2130908	10	10	Pass	Pass	3.57	0.30
Rocky Gorge Dam	3	2131107	10	10	Pass	Pass	3.43	0.27
Brighton Dam	3	2131108	11	11	Ind.	Pass	3.61	0.28
Town Creek	1	2140512	16	20	Ind.	Pass	2.17	0.06
Potomac River Lower North Br ¹	1	2141001	15	15	Fail	Pass		
Savage River	1	2141006	13	14	Pass	Pass	2.48	0.06
Median ³							3.3	
75 th Percentile							3.6	

Notes:

1. Potomac River Lower North Branch determined to be an outlier through statistical analysis and best professional judgment.
2. Sediment Yields (including normalized) based on Maryland watershed area only (Consistent with MBSS random monitoring data).
3. Median rounded down (3.36 to 3.3) as conservative estimate
4. Ind.= Indeterminate

Table A-2: Reference watersheds land use

MD 8-digit Name	MD 8-digit	Crop	Extractive	Forest	Pasture	Urban
Deer Creek	2120202	23	0	50	11	16
Broad Creek	2120205	24	0	48	10	17
Little Gunpowder Falls	2130804	15	0	45	16	23
Prettyboy Reservoir	2130806	20	0	50	14	16
Liberty Reservoir	2130907	22	0	38	10	30
S Branch Patapsco	2130908	23	0	33	11	33
Rocky Gorge Dam	2131107	15	0	40	12	33
Brighton Dam	2131108	17	0	41	25	17
Town Creek	2140512	5	0	84	7	4
Potomac River Lower North Br	2141001	4	0	74	6	16
Savage River	2141006	5	0	86	4	5

Note: All values have been rounded to nearest whole number percentage.

Table A-3: MBSS data for sites with BIBI significantly > 3

MBSS Site	Epifaunal Substrate	Embeddedness
PRMO-110-R-2002	14	30
PRMO-115-R-2002	16	25
PRMO-202-R-2002	13	35
PRMO-304-R-2002	13	25
SENE-104-R-2001	10	25
UMON-119-R-2000	18	25
UMON-221-R-2000	16	30
UMON-230-R-2000	20	20
UMON-304-R-2000	16	30
DOUB-116-R-2002	16	20
DOUB-119-R-2002	12	35
DOUB-221-R-2002	14	35
DOUB-407-R-2002	8	45
CATO-104-R-2003	14	15
CATO-106-R-2003	14	30
CATO-214-R-2003	12	40
PRWA-103-R-2000	10	30
PRWA-122-R-2000	12	20
PRWA-124-R-2002	11	35
ANTI-113-R-2003	14	35
ANTI-208-R-2003	9	30
LCON-119-R-2004	15	25
LIKG-103-R-2004	18	20
LIKG-113-R-2004	16	25
LIKG-115-R-2004	8	42
LIKG-211-R-2004	16	30
PRAL-107-R-2001	14	15
PRAL-208-R-2001	16	10
SIDE-402-R-2001	16	15
SIDE-410-R-2001	16	20
FIMI-106-R-2000	12	10
FIMI-109-R-2000	17	10
FIMI-110-R-2000	14	10
FIMI-202-R-2000	14	10
FIMI-401-R-2000	17	10
FIMI-407-R-2000	18	10
TOWN-101-R-2000	11	25
TOWN-102-R-2000	10	10
TOWN-108-R-2002	15	20
TOWN-110-R-2000	15	10
TOWN-113-R-2000	11	15
TOWN-116-R-2002	12	40
TOWN-205-R-2002	14	20
TOWN-408-R-2000	17	15
TOWN-409-R-2000	16	15

MBSS Site	Epifaunal Substrate	Embeddedness
TOWN-412-R-2000	18	10
TOWN-417-R-2002	18	20
TOWN-419-R-2002	17	20
TOWN-420-R-2002	16	20
PRLN-104-R-2003	11	35
PRLN-107-R-2003	8	35
PRLN-108-R-2003	11	35
PRLN-109-R-2003	19	15
PRLN-113-R-2003	19	15
PRLN-115-R-2003	16	20
PRLN-119-R-2003	13	25
PRLN-122-R-2003	17	30
PRLN-201-R-2003	11	35
PRLN-306-R-2003	13	25
PRLN-316-R-2003	12	35
PRLN-318-R-2003	17	20
PRLN-321-R-2003	13	40
EVIT-102-R-2004	6	30
EVIT-110-R-2004	9	35
WILL-105-R-2004	10	35
WILL-109-R-2004	10	35
WILL-115-R-2004	15	30
WILL-120-R-2004	14	30
WILL-404-R-2004	10	25
GEOR-103-R-2003	16	45
GEOR-106-R-2003	13	35
GEOR-107-R-2003	12	35
GEOR-114-R-2003	12	35
GEOR-211-R-2003	12	30
PRUN-102-R-2001	14	45
PRUN-107-R-2001	17	15
PRUN-205-R-2001	18	15
SAVA-103-R-2002	12	30
SAVA-104-R-2002	19	15
SAVA-105-R-2002	13	35
SAVA-116-R-2002	15	25
SAVA-117-R-2002	12	20
SAVA-119-R-2002	18	15
SAVA-120-R-2002	17	15
SAVA-206-R-2002	12	20
SAVA-308-R-2002	18	20
SAVA-312-R-2002	18	15
SAVA-401-R-2002	18	20
SAVA-410-R-2002	17	25
SAVA-414-R-2002	18	20
YOUG-101-R-2001	13	20
YOUG-106-R-2001	16	15
YOUG-107-R-2001	15	38

MBSS Site	Epifaunal Substrate	Embeddedness
YOUG-117-R-2001	11	35
YOUG-123-R-2001	14	20
YOUG-208-R-2001	16	25
YOUG-221-R-2001	18	35
YOUG-320-R-2001	13	25
LYOU-110-R-2004	5	50
LYOU-118-R-2004	9	50
LYOU-219-R-2004	8	50
DCRL-109-R-2004	6	40
CASS-104-R-2000	17	15
CASS-106-R-2000	12	35
CASS-307-R-2000	14	25

Table A-4: The Lower North Branch Potomac River Watershed MBSS data

Site	Date Sampled Summer	Date Sampled Spring	FIBI	BIBI	Epifaunal Substrate	Percent Embeddedness
PRLN-104-R-2003	12JUN2003	25MAR2003	1.00	3.50	11	35
PRLN-105-R-2003	12JUN2003	25MAR2003	1.00	1.75	15	40
PRLN-107-R-2003	26JUN2003	25MAR2003	1.67	3.75	8	35
PRLN-108-R-2003	07JUL2003	25MAR2003	4.00	3.50	11	35
PRLN-109-R-2003	18JUN2003	26MAR2003	2.00	4.50	19	15
PRLN-113-R-2003	18JUN2003	26MAR2003	2.00	4.75	19	15
PRLN-115-R-2003	07AUG2003	26MAR2003	2.00	4.50	16	20
PRLN-119-R-2003	18JUN2003	27MAR2003	2.00	3.50	13	25
PRLN-120-R-2003	26JUN2003	25MAR2003	1.67	2.00	13	30
PRLN-122-R-2003	07AUG2003	27MAR2003	2.00	4.00	17	30
PRLN-201-R-2003	26JUN2003	25MAR2003	3.33	3.75	11	35
PRLN-306-R-2003	07JUL2003	27MAR2003	3.67	4.25	13	25
PRLN-316-R-2003	07JUL2003	27MAR2003	3.67	4.00	12	35
PRLN-318-R-2003	20AUG2003	31MAR2003	3.33	4.50	17	20
PRLN-321-R-2003	17JUL2003	26MAR2003	1.67	3.75	13	40
Average			2.33± 0.33	3.73± 0.28		

¹ Summer sampling includes FIBI, epifaunal substrate, and embeddedness² Spring sampling includes BIBI

APPENDIX B**Table B-1: Lower North Branch Potomac River Permit Summary**

Permit #	NPDES	County	Facility	City	Type
95DP2186	MD0061204	ALLEGANY	MEXICO FARMS, LLC	CUMBERLAND	Industrial
99DP2937	MD0066079	ALLEGANY	AES WARRIOR RUN	CUMBERLAND	Industrial
99DP3284	MD0068144	ALLEGANY	BROCK STEEL COMPANY	CUMBERLAND	Industrial
95DP0230	MD0021687	ALLEGANY	UPPER POTOMAC RIVER COMMISSION	WESTERNPORT	Industrial (Major)
95DP0300	MD0001422	ALLEGANY	LUKE PAPER COMPANY	LUKE	Industrial (Major)
00DP0713	MD0022748	ALLEGANY	MARYLAND WATER SERVICE, INC. WWTP	PINTO	Municipal
00DP0739	MD0023213	ALLEGANY	RAWLINGS WWTP	RAWLINGS	Municipal
00DP1004A	MD0024759	ALLEGANY	OLDTOWN WWTP	OLDTOWN	Municipal
02DP1031	MD0024937	ALLEGANY	Q-CITY COURTS, INC.	WESTERNPORT	Municipal
02DP3402A	MD0068896	ALLEGANY	BARTON BUSINESS PARK WWTP	CUMBERLAND	Municipal
04DP2883A	MD0065749	ALLEGANY	BIERS LANE WWTP	RAWLINGS	Municipal
01DP0567	MD0021598	ALLEGANY	CUMBERLAND WWTP	CUMBERLAND	Municipal (Major)
03DP2625A	MD0063878	ALLEGANY	CELANESE WWTP	CUMBERLAND	Municipal (Major)
00MM9897	MDG499897	ALLEGANY	FROSTBURG CONCRETE, LLC	VALE SUMMIT	General - Mining
02SW0301	N/A	ALLEGANY	SUPERFOS PACKAGING, INC.	CUMBERLAND	General - Mining
02SW0827	N/A	ALLEGANY	FIBRED-MARYLAND, INC.	CUMBERLAND	General - Industrial Stormwater
02SW1050	N/A	ALLEGANY	PITT OHIO EXPRESS, INC. - CUMBERLAND	CUMBERLAND	General - Industrial Stormwater
02SW1339	N/A	ALLEGANY	SHA - LA VALE SHOP	LA VALE	General - Industrial Stormwater
02SW1730	N/A	ALLEGANY	CUMBERLAND WWTP	CUMBERLAND	General - Industrial Stormwater
02SW1733	N/A	ALLEGANY	CELANESE WWTP	CUMBERLAND	General - Industrial Stormwater

Table B-2: Municipal Permits

Permit #	NPDES	County	Facility	City	Permitted TSS Load (lb/day)	Permitted TSS Load (Ton/yr)
02DP3402A	MD0068896	ALLEGANY	BARTON BUSINESS PARK WWTP	CUMBERLAND	7.5	1.4
04DP2883A	MD0065749	ALLEGANY	BIERS LANE WWTP	RAWLINGS	2.4	0.4
00DP0713	MD0022748	ALLEGANY	MARYLAND WATER SERVICE, INC. WWTP	PINTO	338.0	61.7
00DP1004A	MD0024759	ALLEGANY	OLDTOWN WWTP	OLDTOWN	4.5	0.8
02DP1031	MD0024937	ALLEGANY	Q-CITY COURTS, INC.	WESTERNPORT	3.8	0.7
00DP0739	MD0023213	ALLEGANY	RAWLINGS WWTP	RAWLINGS	54.0	9.9
00DP2131	MD0060739	ALLEGANY	TRI-TOWNS INDUSTRIAL PARK WWTP	MCCOOLE	0.8	0.1
03DP2625A	MD0063878	ALLEGANY	CELANESE WWTP	CUMBERLAND	470.0	224.5
01DP0567	MD0021598	ALLEGANY	CUMBERLAND WWTP	CUMBERLAND	3800.0	693.5
				Total	4681.0	993.0

Table B-3: Industrial Permits

Permit #	NPDES	Facility	Design flow (MGD ¹)	Permit TSS (mg/l ²)	TSS Load (ton/yr)	Observed flow (MGD)	Observed TSS (mg/l)	Observed TSS Load (ton/yr)
99DP2937	MD0066079	AES WARRIOR RUN	0.0009	30	0.0	0.2000	1.7	0.5
99DP3284	MD0068144	BROCK STEEL COMPANY	0.0010	N/A		0.0016	24	0.1
95DP2186	MD0061204	MEXICO FARMS, LLC	0.2050	30	9.4			19.5
95DP0300	MD0001422	LUKE PAPER COMPANY	19.3	N/A	173.4			173.4
95DP0230	MD0021687	UPPER POTOMAC RIVER COMMISSION	20.1	90	2,753.4			2,594.8

¹ Millions of Gallons per day² Milligrams per liter**Notes**

- 1) Design flow and TSS limit from PCS
- 2) Observed flow and TSS from 2/8/2006 DMR
- 3) Average load reported in lb/day from Jan 01 to Dec 01
- 4) Load from permit based on 950 lb/day
- 5) Industrial and municipal waste water

Table B-4: General Industrial Stormwater Permits

Permit #	County	Facility	City	Status	Stat date	Type	Area (Acres)
02SW1733	ALLEGANY	CELANESE WWTP	CUMBERLAND	IN	5/1/2003	WMA5SW	***
02SW1730	ALLEGANY	CUMBERLAND WWTP	CUMBERLAND	IN	5/1/2003	WMA5SW	7
02SW0827	ALLEGANY	FIBRED-MARYLAND, INC.	CUMBERLAND	IR	3/26/2003	WMA5SW	5.05
02SW1050	ALLEGANY	PITT OHIO EXPRESS, INC. - CUMBERLAND	CUMBERLAND	IR	3/13/2003	WMA5SW	5
02SW1339	ALLEGANY	SHA - LA VALE SHOP	LA VALE	IR	6/16/2003	WMA5SW	14.3
02SW0301	ALLEGANY	SUPERFOS PACKAGING, INC.	CUMBERLAND	IR	2/12/2003	WMA5SW	7

*** Permit page with acreage is missing from file

Table B-5: General Mine Permits

NPDES	County	Facility	City	Current Acres	Total Acres	Average flow, gpd (per permit)
MDG499897	ALLEGANY	FROSTBURG CONCRETE, LLC	VALE SUMMIT	1	***	50

*** Total acres are not noted in permit file.